generator rectifier **54** can supply voltages as high as 550 volts DC, requiring two capacitors to be series connected to sustain that voltage.

The two IGBTs **74** and **78** in IGBT channel **70** function in the generate mode to form a constant duty fifty percent duty cycle divider to maintain exactly half bus voltage at the center tap at all times. That center tap point forms the neutral for the AC output. The neutral is not required for generator starting but is required for utility interface. The IGBT channels **71**, **72**, and **73** form a classic six transistor PWM inverter.

The reconfiguration or conversion of the PWM inverter **49** to be able to operate as a current source synchronous with the utility grid is accomplished by first stopping the PWM inverter **49**. The AC output or the grid connect point is monitored with a separate set of logic monitoring to bring the PWM inverter **49** up in a synchronized fashion. The generator contactor **53** functions to close and connect only when the PWM inverter **49** needs to power the permanent magnet turbogenerator/motor **10** which is during the start operation and during the cool down operation. The output contactor **52** is only enabled to connect the PWM inverter **49** to the grid once the PWM inverter **49** has synchronized with grid voltage.

The implementation of the control power supply **56** first drops the control power supply **56** down to a 24 volt regulated section to allow an interface with a battery or other control power device. The control power supply **56** provides the conventional logic voltages to both the IGBT gate drives **58** and control logic **57**. The IGBT gate drives **58** have two isolated low voltage sources to provide power to each of the two individual IGBT drives and the interface to the IGBT transistors is via a commercially packaged chip.

This system is also capable of generating 480 volt output directly. By changing the winding in the permanent magnet generator/motor **12**, the voltage ratings of the IGBTs, and the bus capacitors **48**, the system is then capable of operating directly at 480 volts, starting from grid voltage with 480 volts, and powering directly to 480 volts without requiring a transformer.

While specific embodiments of the invention have been illustrated and described, it is to be understood that these are provided by way of example only and that the invention is not to be construed as being limited thereto but only by the proper scope of the following claims.

What we claim is:

1. A method of controlling a permanent magnet turbogenerator/motor comprising the steps of:

providing electrical power to the permanent magnet turbogenerator/motor through a pulse width modulated inverter to start the permanent magnet turbogenerator/motor to achieve self sustaining operation of the permanent magnet turbogenerator/motor;

disconnecting the electrical power from the pulse width modulated inverter once self sustaining operation of the permanent magnet turbogenerator/motor is achieved; and

reconfiguring the pulse width modulated inverter to supply voltage from the permanent magnet turbogenerator/motor.

2. The method of controlling a permanent magnet turbogenerator/motor of claim 1 wherein the voltage supplied from the pulse width modulated inverter of the permanent magnet turbogenerator/motor is utility frequency voltage.

3. The method of controlling a permanent magnet turbogenerator/motor of claim 1 wherein the pulse width modulated inverter includes four solid state switching device channels, and three of the four solid state switching device channels are reconfigured to supply utility frequency voltage and the fourth solid state switching device channel is switched at a fifty percent duty cycle to create an artificial neutral.

4. A method of controlling a permanent magnet turbogenerator/motor comprising the steps of:

providing electrical power to the permanent magnet turbogenerator/motor through a pulse width modulated inverter to drive the permanent magnet turbogenerator/motor as a motor to accelerate the gas turbine engine of the permanent magnet turbogenerator/motor;

providing spark and fuel to the gas turbine engine of the permanent magnet turbogenerator/motor during this acceleration to achieve self sustaining operation of the gas turbine engine;

disconnecting the electrical power from the pulse width modulated inverter once self sustaining operation is achieved; and

reconnecting the pulse width modulated inverter to the permanent magnet turbogenerator/motor through a rectifier bridge to reconfigure the pulse width modulated inverter to supply utility frequency voltage.

5. The method of controlling a permanent magnet turbogenerator/motor of claim 4 wherein the pulse width modulated inverter includes four solid state switching device channels, and three of the four solid state switching device channels are reconfigured to supply utility frequency voltage and the fourth solid state switching device channel is switched at a fifty percent duty cycle to create an artificial neutral.

6. A method of controlling a permanent magnet turbogenerator/motor comprising the steps of:

providing electrical power to the permanent magnet turbogenerator/motor through a first contactor and a pulse width modulated inverter to drive the permanent magnet turbogenerator/motor as a motor through a second contactor to accelerate the gas turbine engine of the permanent magnet turbogenerator/motor;

providing spark and fuel to the gas turbine engine of the permanent magnet turbogenerator/motor during this acceleration to achieve self sustaining operation of the gas turbine engine;

opening the first and second contactors to disconnect the electrical power from the pulse width modulated inverter once self sustaining operation is achieved; and

reconnecting the pulse width modulated inverter to the permanent magnet turbogenerator/motor through a rectifier bridge to reconfigure the pulse width modulated inverter to supply utility frequency voltage.

7. The method of controlling a permanent magnet turbogenerator/motor of claim 6 wherein the pulse width modulated inverter includes four solid state switching device channels, and three of the four solid state switching device channels are reconfigured to supply utility frequency voltage and the fourth solid state switching device channel is switched at a fifty percent duty cycle to create an artificial neutral.

8. The method of controlling a permanent magnet turbogenerator/motor of claim 6 and in addition the step of connecting the reconfigured pulse width modulated inverter to a load by closing a third contactor.

9. A method of controlling a permanent magnet turbogenerator/motor comprising the steps of:

providing electrical power to the permanent magnet turbogenerator/motor through a first contactor and a

multiple solid state switching device channel pulse width modulated inverter to drive the permanent magnet turbogenerator/motor as a motor through a second contactor to accelerate the gas turbine engine of the permanent magnet turbogenerator/motor;

providing spark and fuel to the gas turbine engine of the permanent magnet turbogenerator/motor during this acceleration to achieve self sustaining operation of the gas turbine engine;

opening the first and second contactors to disconnect the electrical power from the multiple solid state switching device channel pulse width modulated inverter once self sustaining operation is achieved;

reconnecting the multiple solid state switching device channel pulse width modulated inverter to the permanent magnet turbogenerator/motor through a high frequency rectifier bridge to reconfigure the multiple solid state switching device channel pulse width modulated inverter; and

connecting the reconfigured multiple solid state switching device channel pulse width modulated inverter to utility power by closing a third contactor.

10. The method of controlling a permanent magnet turbogenerator/motor of claim **9** wherein the number of multiple solid state switching device channels in said pulse width modulated inverter is four, and three of the four solid state switching device channels are reconfigured to supply utility frequency voltage and the fourth solid state switching device channels is switched at a fifty percent duty cycle to create an artificial neutral.

11. The method of controlling a permanent magnet turbogenerator/motor of claim **10** wherein the four solid state switching device channels are IGBT channels.

12. The method of controlling a permanent magnet turbogenerator/motor of claim **9** wherein the high frequency rectifier bridge is a three phase rectifier having three diode channels.

13. The method of controlling a permanent magnet turbogenerator/motor of claim **12** wherein each of said three diode channels include a pair of diodes.

14. A controller for a permanent magnet turbogenerator/motor, comprising:

a pulse width modulated inverter operably associated with said permanent magnet turbogenerator/motor;

means to provide electrical power to said permanent magnet turbogenerator/motor through said pulse width modulated inverter to start said permanent magnet turbogenerator/motor to achieve self sustaining operation of said permanent magnet turbogenerator/motor;

means to disconnect the electrical power from said pulse width modulated inverter once self sustaining operation of said permanent magnet turbogenerator/motor is achieved; and

means to reconfigure said pulse width modulated inverter to supply voltage from said permanent magnet turbogenerator/motor.

15. The controller for a permanent magnet turbogenerator/motor of claim **14** wherein said pulse width modulated inverter includes a plurality of solid state switching device channels.

16. A controller for a permanent magnet turbogenerator/motor, comprising:

a pulse width modulated inverter operably associated with said permanent magnet turbogenerator/motor, said pulse width modulated inverter having four solid state switching device channels;

means to provide electrical power to said permanent magnet turbogenerator motor through said pulse width modulated inverter to start said permanent magnet turbogenerator/motor to achieve self sustaining operation;

means to disconnect the electrical power from said pulse width modulated inverter once self sustaining operation of said permanent magnet turbogenerator/motor is achieved; and

means to reconfigure said pulse width modulated inverter to supply voltage from said permanent magnet turbogenerator/motor, and three of the four solid state switching device channels are reconfigured to supply utility frequency voltage and the fourth solid state switching device channel is switched at a fifty percent duty cycle to create an artificial neutral.

17. The controller for a permanent magnet turbogenerator/motor of claim **16** wherein said four solid state switching device channels are IGBT channels.

18. The controller for a permanent magnet turbogenerator/motor of claim **14** wherein the voltage supplied from said pulse width modulated inverter associated with said permanent magnet turbogenerator/motor is utility frequency voltage.

19. A controller for a permanent magnet turbogenerator/motor having a gas turbine engine, comprising:

a pulse width modulated inverter operably associated with said permanent magnet turbogenerator/motor;

means to provide electrical power to said permanent magnet turbogenerator/motor through said pulse width modulated inverter to drive said permanent magnet turbogenerator/motor as a motor to accelerate said gas turbine engine of said permanent magnet turbogenerator/motor;

means to provide spark and fuel to said gas turbine engine of said permanent magnet turbogenerator/motor during this acceleration to achieve self sustaining operation of said gas turbine engine;

means to disconnect the electrical power from said pulse width modulated inverter and said permanent magnet turbogenerator/motor once self sustaining operation of said gas turbine engine is achieved;

a rectifier bridge operably associated with said pulse width modulated inverter and said permanent magnet turbogenerator/motor; and

means to reconnect said pulse width modulated inverter to said permanent magnet turbogenerator/motor through said rectifier bridge to reconfigure said pulse width modulated inverter to supply utility frequency voltage.

20. The controller for a permanent magnet turbogenerator/motor having a gas turbine engine of claim **19** wherein said pulse width modulated inverter includes four solid state switching device channels, and three of the four solid state switching device channels are reconfigured to supply utility frequency voltage and the fourth solid state switching device channel is switched at a fifty percent duty cycle to create an artificial neutral.

21. A controller for a permanent magnet turbogenerator/motor having a gas turbine engine and a permanent magnet generator/motor, comprising:

a pulse width modulated inverter operably associated with said permanent magnet turbogenerator/motor, said pulse width modulated inverter having a plurality of solid state switching device channels;

a first contactor operably associated with said pulse width modulated inverter;

a second contactor operable associated with said the permanent magnet turbogenerator/motor,

means to provide electrical power to said pulse width modulated inverter through said first contactor when closed to drive said permanent magnet turbogenerator/motor as a motor through said second contactor when closed to accelerate said gas turbine engine of said permanent magnet turbogenerator/motor;

means to provide spark and fuel to said gas turbine engine of said permanent magnet turbogenerator/motor during this acceleration to achieve self sustaining operation of said gas turbine engine;

means to open said first and second contactors to disconnect the electrical power from said pulse width modulated inverter once self sustaining operation is achieved;

a rectifier bridge operable associated with said pulse width modulated inverter and said permanent magnet turbogenerator/motor;

a third contactor operably associated with said pulse width modulated inverter;

means to reconnect said pulse width modulated inverter to said permanent magnet turbogenerator/motor through said rectifier bridge to reconfigure said pulse width modulated inverter; and

means to connect said reconfigured pulse width modulated inverter to supply utility frequency voltage to a load through said third contactor when closed.

22. The controller for a permanent magnet turbogenerator/motor of claim 21 wherein the number of solid state switching device channels in said pulse width modulate inverter is four, and three of the four solid state switching device channels are reconfigured to supply utility frequency voltage and the fourth solid state switching device channel is switched at a fifty percent duty cycle to create an artificial neutral.

23. The controller for a permanent magnet turbogenerator/motor of claim 22 wherein the four solid state switching device channels are IGBT channels.

24. The controller for a permanent magnet turbogenerator/motor of claim 21 wherein said rectifier bridge is a three phase rectifier having three diode channels.

25. The controller for a permanent magnet turbogenerator/motor of claim 24 wherein each of said three diode channels includes a pair of diodes.

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